Tetanus in California

Epidemiology and a Review of 232 Cases

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• **A study was made of records of the 232 reported cases of tetanus in California, from 1953 through 1958. Cases occurred in 30 of California's 58 counties. Two-thirds of the patients lived in suburban and urban areas. Two-thirds of the cases occurred in persons over the age of 20 years. The incidence was twice as high in males as in females. Forty-seven per cent of the patients died, with the highest death rates being in persons over the age of 40 years.**

Sixty-three per cent of the injuries associated with these 232 cases occurred in the home environment and 17 per cent at the place of employment.

Ninety-one per cent of the patients had never been immunized with tetanus toxoid, or if they had been immunized, had not received the booster injections necessary to maintain effective immunity. Nine per cent gave a history of having had one or more injections of tetanus toxoid within five years.

TETANUS SINCE ANCIENT TIMES has been a much feared, agonizing and highly lethal disease. In recent times medical science has provided effective means for its prevention. Yet in California from 1920 through 1958 there were reported 2,383 cases of tetanus with 1,381 deaths, a mortality rate of 58 per cent.

The purpose of this report is to review certain aspects of recent experience with this disease and stress the importance of wider use of tetanus toxoid for active immunization.

For the period 1953 through 1958 information was collected by the State Department of Public Health, with the cooperation of practicing physicians and local health officers, concerning 232 cases of tetanus. This information, collected for each reported case, on a form entitled "Epidemiologic Case History of Tetanus" has provided the material for this report.

Cases of tetanus have been reported from 30 of California's 58 counties during the past six years (Table 1). One hundred and ten cases occurred in Los Angeles County. The remaining 122 cases were widely scattered: 17 were in Orange County, 12 each in San Bernardino and San Diego counties, 10 in Fresno, 8 in Alameda and 7 or fewer in each of the remaining 24 counties.

Table 2 shows the number of cases reported, the number of deaths and the mortality rate. Although considerably lower than the mortality rate of 82 per cent for the period 1920 through 1924,[1] the rate of 47 per cent for the years 1953 through 1958 was still extremely high.

Who gets tetanus and in what circumstances? Previous reports from other parts of the nation have indicated that tetanus occurs most frequently among inhabitants of rural areas. In this series, however, approximately two thirds of the patients lived in cities, suburban areas and towns. Farm workers who had the disease were outnumbered by skilled

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TABLE 1.—*Tetanus in California by County of Occurrence (1953-1958)*

County	Cases	County	Cases
Alameda	8	San Bernardino	12
Butte	1	San Diego	12
Contra Costa	3	San Francisco	1
Fresno	10	San Joaquin	6
Humboldt	4	San Luis Obispo	2
Imperial	1	Santa Clara	5
Kern	7	Santa Cruz	2
Los Angeles	110	Solano	1
Marin	3	Sonoma	2
Merced	1	Stanislaus	2
Monterey	1	Sutter	1
Orange	17	Trinity	1
Placer	1	Tulare	3
Riverside	5	Ventura	5
Sacramento	1	Yolo	1

TABLE 2.—*Tetanus Cases and Deaths in California, 1920-24 and 1953-58 by Year*

Year	Cases	Deaths	Per Cent of Cases Dying
1920-24	264	216	82
1953	42	18	43
1954	47	23	49
1955	34	16	47
1956	34	14	41
1957	32	16	50
1958	43	22	51
Total 1953-58	232	109	47

and unskilled industrial workers by a ratio of approximately three to one.

Tetanus occurs in both sexes and in all age groups. Two-thirds of the cases reported upon herein occurred in adults. There were 160 cases in males and 72 in females, a ratio of 2.2 to one. The death rate was higher in females (53 per cent) than in males (44 per cent).

The two youngest patients were 17 and 21 days old; each had an infection of the umbilical cord stump. The two oldest patients were an 81-year-old housewife whose foot was punctured by a nail while she was walking in a chickenyard at the rear of her home, and an 81-year-old man whose thumb was lacerated while he was cutting old lumber with a power saw at his home.

When considered by ten-year age groups, children under the age of ten years were the most frequent victims of tetanus; they made up 21 per cent of the total number of patients (Table 3). Tetanus occurred least frequently in young adults 20 to 29 years old; 7 per cent of the cases were in that bracket. However, a considerable proportion of the cases occurred in each ten-year age group from the very young to the very old.

It has been pointed out elsewhere[2] that in tetanus the age of the patient has a definite relationship to the survival rate. Fifty-three per cent of the 232 patients in the present series recovered (Table 3). The highest survival rate, 79 per cent, was in patients in the 10 through 19 age group. The poorest recovery rate, 23 per cent, was in the 70 through 79 age group; and the rates were substantially lower in all age groups over 40 years.

Seventy-eight per cent of the cases and 68 per cent of the deaths in this series occurred in connection with minor injuries (Table 4). The public traditionally associates minor puncture wounds (stepping on a rusty nail) with tetanus. Slightly less than one-third (31 per cent) of the 232 cases reviewed here were associated with minor puncture wounds from nails, slivers, thorns or other sharp objects. Of the 182 cases in the minor injury group, 39 per cent were associated with puncture wounds and 61 per cent with other types of injuries. Twenty-one per cent were associated with lacerations, 16 per cent with abrasions and 8 per cent with crushing injuries to fingers or toes. The remaining 16 per cent were associated with minor lesions and injuries of various types, including burns, blisters, ulcers and ingrown toenails.

In the major injury group tetanus was associated most frequently with lacerations and compound fractures. Gangrenous lesions, abortions, burns, bullet or knife wounds, major surgical procedures and crushing injuries were each associated with five cases or fewer.

Sixty-three per cent of the injuries in the 232 cases occurred in the home environment (Table 5).

TABLE 3.—*Tetanus in California, 1953-1958; Reported Cases by Age Group—Fatality and Survival*

Age Group	Number Cases	Number Recovered	Number Died	Per Cent of Total Died	Per Cent of Total Recovered
All ages	232	123	109	47.0	53.0
0 to 9	49	32	17	34.7	65.3
10 to 19	34	27	7	20.6	79.4
20 to 29	16	10	6	37.5	62.5
30 to 39	19	12	7	36.8	63.2
40 to 49	37	16	21	56.7	43.3
50 to 59	25	8	17	68.0	32.0
60 to 69	32	14	18	56.2	43.8
70 to 79	17	4	13	76.5	23.5
80+	3	....	3	All	....

TABLE 4.—*Tetanus in California; Cases and Deaths by Type of Injury 1953-58*

MINOR INJURIES Type of Injury	Cases	Deaths
Total	182	74
Punctures:		
Nail	28	14
Slivers	25	11
Other	19	9
Lacerations	38	16
Abrasions	30	11
Crushed finger or toe	16	5
Blisters	4	....
Ulcers	4	....
Burns (minor)	2	....
Infections:		
Ingrown toe nails	6	3
Umbilical cord	2	1
Infected ear	1	....
Infected gums	1	1
Infected insect bite	1	1
Tooth extraction	1	....
Other minor surgery	4	2

MAJOR INJURIES Type of Injury	Cases	Deaths
Total	46	35
Compound Fractures:		
Highway accident	4	4
Other	8	6
Lacerations	15	12
Gangrene:		
Diabetic	2	2
Other	3	3
Surgery (major)	3	2
Burns (severe)	3	2
Abortion	4	4
Bullet or knife (puncture wound)	3	....
Crushed foot	1	....
No known injury	4	....

TABLE 5.—*Tetanus Cases by Place of Injury; California, 1953-58*

Place	No. of Cases	Per Cent
Total	232	100
Home and yard	145	63
At work	39	17
Highway accident	6	2.2
Other	34	14.5
Unknown	8	3.3

Seventeen per cent occured at the place of employment, 2.2 per cent were received in highway accidents and 14.5 per cent occurred in a variety of other places including the public streets and sidewalks, public parks and playgrounds, abortionists' "offices," vacant lots, a night club and a cow pasture.

Ninety-one per cent of the 208 patients for whom information on this subject was obtained had either never been immunized with tetanus toxoid or had been inadequately immunized[5] in the sense that the last injection of tetanus toxoid had been received more than five years before the injury (Table 6). Nine per cent gave a history of having been immunized within five years. However, detailed information was not obtained with reference to the exact dates of immunization and the number of injections. Immunization histories are not always reliable. People often recall with difficulty and inaccurately information concerning what "shots" they or other members of their family have had and when they were received. In one case, for example, a child lacerated an arm in a fall in the street. A responsible adult in the family informed the attending physician that the child had received the usual immunizations for tetanus, diphtheria and pertussis in the city where the family had formerly lived. On the basis of this information the physician administered a booster injection of tetanus toxoid but did not give antitoxin. Some days later tetanus developed and the child died. Subsequent inquiry revealed that there were nine children in the family and while the records showed that some of them had been immunized, this particular child had not. It is probable that if complete and accurate information concerning their immunization history could could be obtained, some of the 19 patients listed in Table 6 as having had immunization within five years, would be moved over to the category of "inadequately immunized" or "no immunization." Some of them, however, would probably have had low levels of antitoxin simply because they responded poorly to the antigenic stimulus of the vaccine.

The data in Table 6 are in agreement with previous studies in the Armed Forces[4] in which the high degree of effectiveness of active immunization with tetanus toxoid as a preventive measure is well documented.

Twenty-four (12 per cent) of the 196 patients

TABLE 6.—*Tetanus in California, 1953-1958; History of Active Immunization with Tetanus Toxoid Before Injury in 208 Cases*

	No Immunization	Over 5 Years Ago	Within 5 Years	Total
Cases	166	23	19	208
Per cent	80	11	9	100

TABLE 7.—*Tetanus in California, 1953-1958; Use of Antitoxin Prophylactically After Injury But Before Onset of Symptoms*

Amount of Antitoxin	No. of Cases	Recovered	Died
None	196	107	89
1,500 units	20	9	11
3,000 units	3	2	1
4,500 units	1	....	1

TABLE 8.—*Tetanus in California, 1953-58; Results in 203 Cases in Which Antitoxin Was Used for Therapy After Onset of Symptoms*

Antitoxin (1,000 Units)	Total	Recovered	Died
	203	110	93
Under 50	22	12	10
50 to 99	25	19	6
100 to 149	27	14	13
150 to 199	55	25	30
200 to 249	48	25	23
250 to 299	8	5	3
300 and over	18	10	8

for whom information was provided on this point, received a prophylactic injection of antitoxin at the time of the injury (Table 7). Twenty of these received the usual dose of 1,500 units. While the number of cases is too small to be statistically significant, the 55 per cent mortality rate in this group lends support to investigators who advocate 3,000 units of antitoxin as the minimum prophylactic dose.

An important point is that approximately 65 per cent of the patients in this series did not report to a physician until the onset of clinical symptoms of tetanus. The usual reason for delay was that the initial injury or lesion was considered to be of a trivial nature, requiring only home remedies. For these persons the prophylactic administration of antitoxin was of course not possible.

Data are provided in Table 8 concerning the use of antitoxin therapeutically in 203 cases. It is beyond the scope of this report to discuss the treatment of tetanus but this information is included in tabular form because it is relevant to the general subject.

DISCUSSION

Tetanus is a disease that is only partially controlled, even though basic knowledge would appear to allow successful control.[3] The causative organism is a natural inhabitant of the intestinal tract of man and animals so constant reseeding of these organisms occurs in man's environment. Hence, contamination of man's frequent wounds makes each of us a

candidate for the possible development of this disease.[2] Universal immunization with tetanus toxoid provides the potential means of protection. In this respect the occurrence of tetanus can be considered to be the result of what has been termed "unassimilated progress." An effective vaccine is available but it has not thus far been used on the broad scale that would appear to be desirable for the protection of the civilian population.

Active immunization with tetanus toxoid has become a routine part of pediatric practice. However, since a majority of the cases occur in the adult population, immunization should become, to a larger extent than at present, a routine part of medical practice for all age groups. A continuing effort is needed to inform the public concerning the availability and protective value of active immunization. Coordinated effort by medical and public health workers, for the purpose of achieving the highest possible levels of community immunization against tetanus offer, in the present state of our knowledge, the best hope for the prevention and control of this disease.

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Discussion by DONALD E. ROSS, *M.D., Los Angeles*

Tetanus is indeed a dreadful disease which has impact on the populace and physicians alike. The great tragedy is that the disease could have been virtually stamped out by a program of universal inoculation with toxoid.

Until we have reached this ideal we still are faced with the problem of treating tetanus-prone wounds and of administering tetanus antitoxin with all of its inherent dangers. Certain points may be briefly stressed:

1. The problem constitutes a serious medico-legal hazard.

2. Thorough cleansing and adequate care of the wound should be emphasized.

3. It has been found that the incidence of tetanus is higher when only 1,500 units of antitoxin are used for prophylaxis than when the dose is 3,000 to 5,000 units.

4. When a highly sensitive patient is encountered it is important to (a) Inquire into the history of allergic reaction, and (b) Let the patient know the dangers.

5. Giving a dose of toxoid to a patient who has not been immunized previously with toxoid is without value.

6. It is now well known that the administration of antitoxin is not as effective in a highly sensitive patient as it is in one not so sensitive.

7. The foregoing shortcomings have led the profession into other fields of research:

(a) Antibiotics of the tetracycline group have been found effective for the prevention of tetanus in animal experimentation. This has not been satisfactorily proven for humans. Evidence is accumulating, however, which gives promise that this group of antibiotics will be effective.

(b) The Cutter Laboratories have prepared a Hyper-Tet gamma globulin fraction from humans who have been hyper-immunized with tetanus toxoid. This preparation would not cause allergic disease or serum sickness.

(c) Transfusions of blood from toxoid-immunized persons are believed to be of value in the treatment of tetanus in highly sensitive patients.